

Changing Landscapes

Shrub Expansion

High School Guide

REACH Up

Raising Educational Achievement
through Cultural Heritage Up

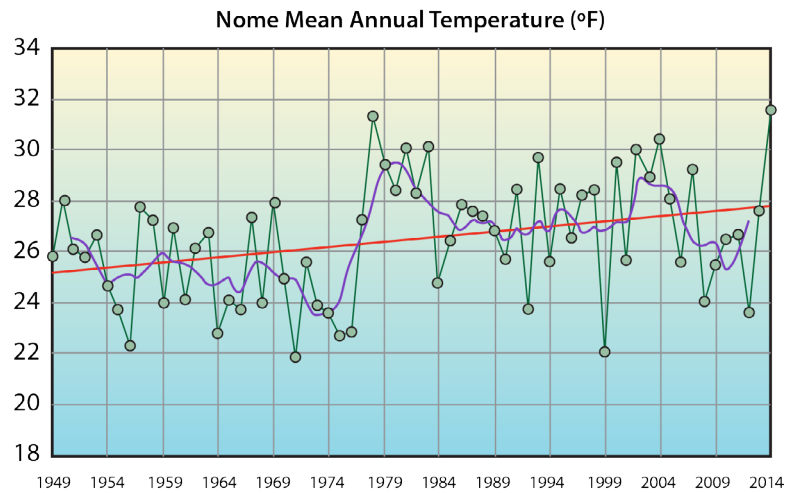
Changing Landscapes

How does climate change impact the landscape?

The climate in the Bering Strait region of western Alaska is warming. Increasing temperatures change the landscape in a variety of ways. Landscape changes impact local ecosystems and ways of life for local residents. What are these changes? What processes cause them? How do these changes impact Bering Strait communities?



Bering Strait, Alaska



Shrub Expansion

One of the frequently discussed impacts of climate change is shrub expansion. It has been referred to as the “greening of the Arctic”. Elders and scientists alike have observed changes in vegetation on the tundra; plants such as spruce trees and tall willow shrubs have grown up in areas where previously only short plants such as blueberries and Labrador tea were found. Scientists have documented these changes using repeat photography.

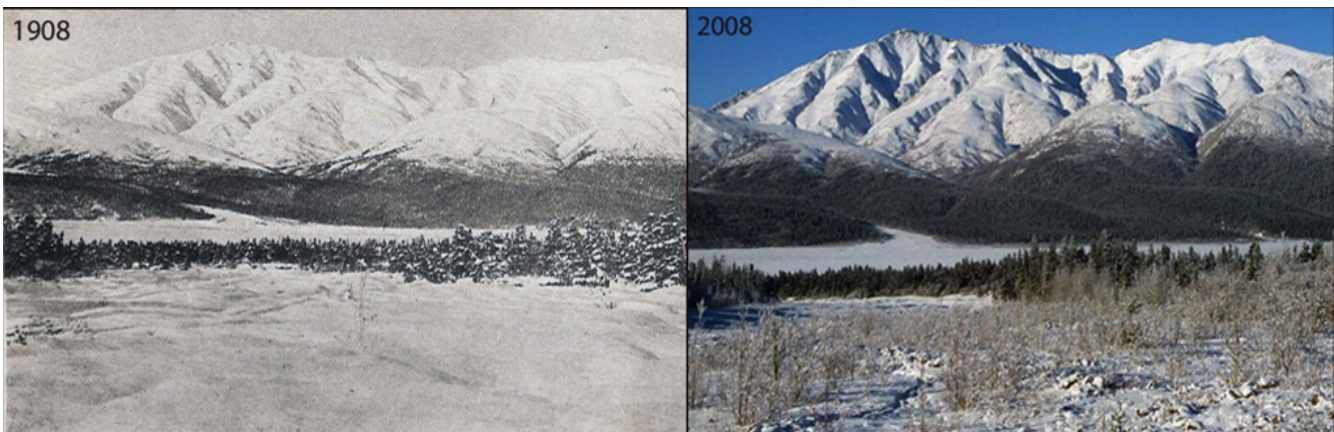


Photo Credit: Charles Sheldon (1908), Willie Karidis (2008), Denali National Park



Impacts of Shrub Expansion

Moose on the Move

Like many environmental changes, shrub expansion brings both benefits and concerns. Taller shrubs decrease visibility, which changes the way people hunt and gather berries. As the vegetation in an area changes, the animal populations will change too.

In recent history, moose have extended their range north. The map below shows the dates when established moose populations were documented in new areas.

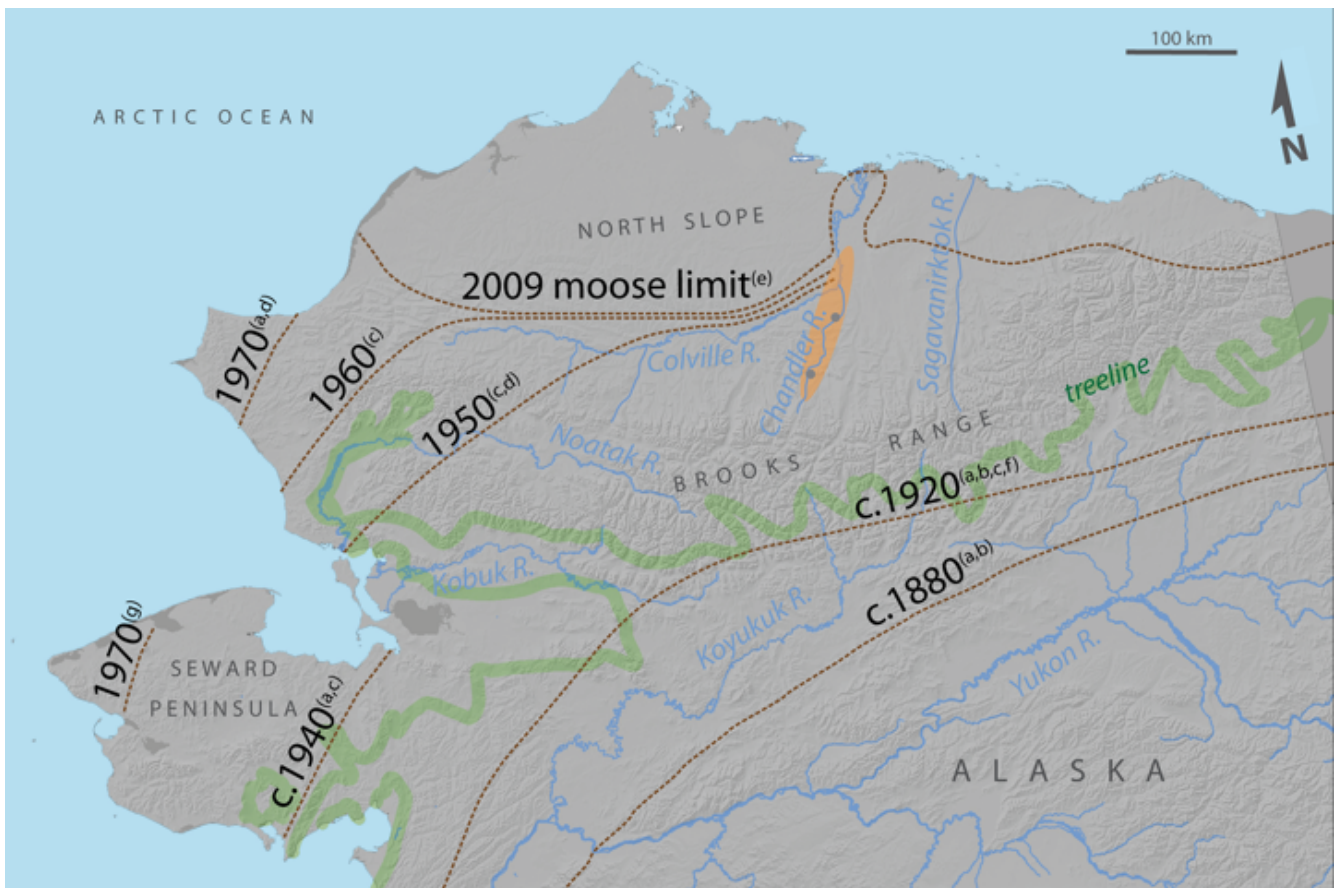


Image credit: Ken D. Tape, et al. "Range Expansion of Moose in Arctic Alaska Linked to Warming and Increased Shrub Habitat". Public Library of Science.



Impacts of Shrub Expansion

Hunting Hypothesis

Moose are a valuable subsistence animal. A successful moose hunt means a large amount of protein-rich food all at once. In some communities, residents can recall the exact date that moose first appeared in their community. When a solitary moose wandered near a human settlement, hunters were of course eager to harvest the large game animal. Some people have hypothesized that moose were kept out of northern and western Alaska for most of the 1900s because of hunting pressure. But hunting may be just one small piece of the puzzle. Current scientific research is looking at the bigger picture. There may be other reasons it takes time for the moose to establish stable, reproducing populations in a new area.

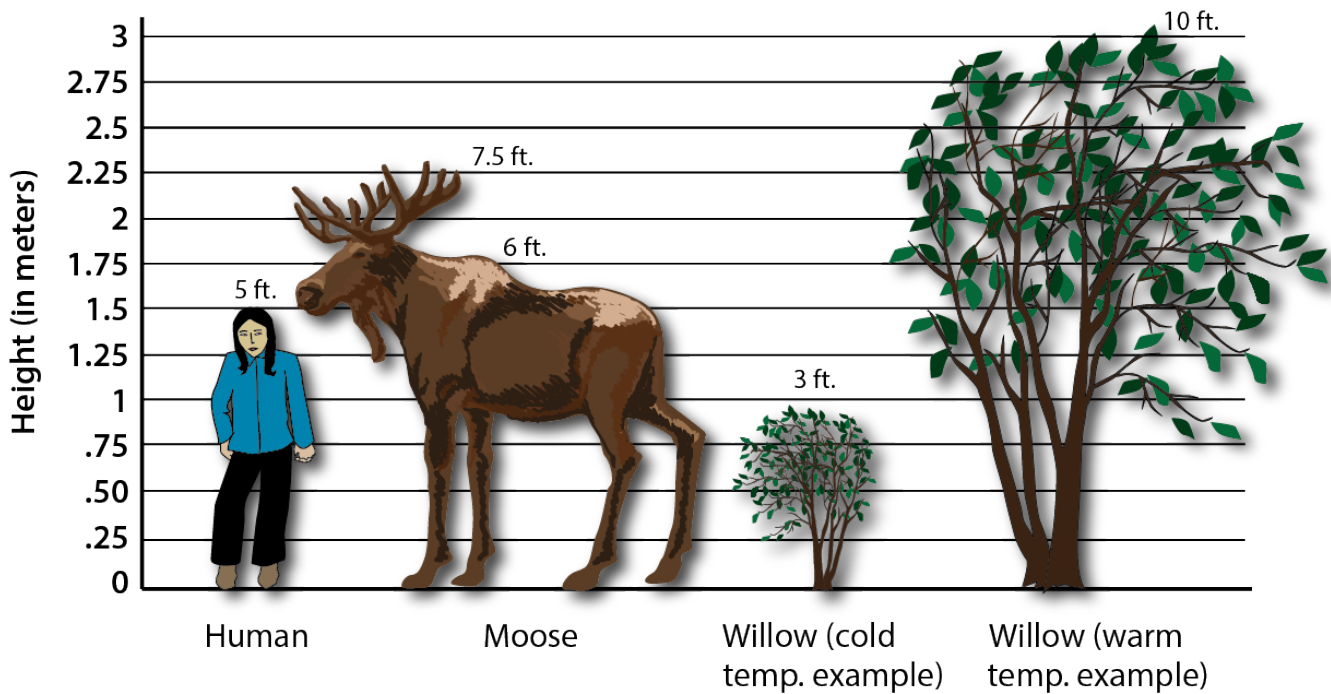


Moose browsing in shrubs. <http://fineartamerica.com/featured/moose-at-sunset-in-winter-yeates-photography.html>

Habitat Hypothesis

Moose are herbivores, feeding on a variety of vegetation in the summer. In the winter, their diet changes and they feed almost exclusively on willow branches. This means that moose have an important wintertime habitat requirement: the willow shrubs must be tall enough that the snow does not cover them. Scientists consider areas with shrubs over two meters in height to be tall shrub habitat while areas where all the shrubs are less than two meters in height are short shrub habitat. Research has shown that moose prefer tall shrub habitat.





Moose primarily browse on Richardson's willow or woolly willow (*Salix richardsonii*) and Alaska willow or feltleaf willow (*Salix alaxensis*). Scientists hypothesize that as Alaska's climate has grown warmer, the shrubs have grown taller, allowing moose to make their home in places where they previously would not have been able to survive through the winter.



Salix richardsonii

<https://nature.ca/aafloora/data/www/wlslal.htm>



Salix alaxensis

<https://nature.ca/aafloora/data/www/wlslal.htm>



Activity

Ask an Expert

1. Watch the video *Vegetation Changes* available at www.k12reach.org/videos.php
2. Conduct your own interview with an elder or cultural knowledge bearer.

Some questions you may want to ask:

- How has the vegetation changed in this area in your lifetime? Are there more willows and shrubs than there used to be? Are the willows growing taller than they used to? (If there are spruce trees in your area, were there spruce trees here when you were younger?)
 - Have changes in vegetation affected hunting, berry picking, and/or transportation?
 - Have you noticed changes in the bird and animal populations? For example, are there moose in the area? Were there moose in the area when you were younger?
3. If your interviewee speaks an Alaska Native language, ask them what language and dialect(s) they are familiar with. Ask them to please translate the following words:
 - Shrub
 - Willow
 - Tundra
 - Moose

Compare your words with the translations on the following page. Are any of the terms the same or similar?



Donna J. Erickson, Unalakleet



Shrub Expansion Vocabulary

Would you like to know Alaska Native language terms related to climate change?

Work with your classmates to practice shrub expansion vocabulary words in English and the indigenous language of your community. Your teacher will give you vocabulary cards with the English word and an illustration on one side. Write the corresponding indigenous term on the blank line on the back of each card. Use the words that you learned from a local elder or cultural knowledge bearer, or choose the translation below that is closest to your community.

Miriam Toolie
Savoonga, AK
Siberian Yupik
St. Lawrence Island Yupik dialect

shrub - uqfilleqqaq
willow - uqfigaq
tundra - nunivak
moose - tungtu

Annie Conger
Nome, AK (from Brevig Mission)
Seward Peninsula Iñupiaq
Bering Strait dialect

shrub - uqpik
willow - uqpik
tundra - nuna
moose - tuttuwak

Luci Washington
St. Michael, AK
Yup'ik
Unaliq dialect

shrub - cyaqsak
willow - uqvik
tundra - nunapik
moose - tuntuvak

Jolene Nanouk
Unalakleet, AK
Seward Peninsula Iñupiaq
Qawiaraq dialect

shrub - uqpik
willow - uqpik
tundra - nuna
moose - tuttuwak



Estimating Shrub Height

Longer Growing Season = Taller Shrubs

Alaska's growing season is lengthening. The spring thaw is happening earlier in the year, the summer days are warmer, and the fall frost is happening later. To calculate the growing season, scientists look at how many days in the year the temperature got above freezing (0°C or 32°F). Days that the air temperature stays below 0°C all day do not count towards the Thaw Degree Days (TDD). For the days that do get above 0°C , the mean temperature for that day is added to a running total. The cumulative total is the TDD.



Willows blooming outside of Kotzebue, P. Clark

The chart on the following page shows the daily temperatures for Nome, AK in May 1915 and May 2015. This data was compiled by NOAA (National Oceanic and Atmospheric Administration). In both 1915 and 2015, Nome saw above freezing temperatures during the month of May. The temperatures were warmer overall in 2015, and you can see the impact those temperatures had on the Thaw Degree Days (TDD) and therefore on the growing season.





Nome, AK May 1915			
Day	Temp F°	Temp C°	TDD
1	30	-1	0
2	30	-1	0
3	34	1	1
4	30	-1	0
5	29	-2	0
6	27	-3	0
7	22	-6	0
8	15	-9	0
9	29	-2	0
10	19	-7	0
11	28	-2	0
12	28	-2	0
13	26	-3	0
14	36	2	2
15	37	3	3
16	36	2	2
17	36	2	2
18	40	4	4
19	35	2	2
20	30	-1	0
21	28	-2	0
22	31	-1	0
23	30	-1	0
24	27	-3	0
25	30	-1	0
26	33	1	1
27	28	-2	0
28	29	-2	0
29	32	0	0
30	34	1	1
31	38	3	3
Thaw Degree Days Month Value			21

Nome, AK May 2015			
Day	Temp F°	Temp C°	TDD
1	22	-6	0
2	25	-4	0
3	22	-6	0
4	28	-2	0
5	29	-2	0
6	29	-2	0
7	34	1	1
8	28	-2	0
9	24	-4	0
10	36	2	2
11	34	1	1
12	29	-2	0
13	36	2	2
14	35	2	2
15	39	4	4
16	34	1	1
17	37	3	3
18	35	2	2
19	36	2	2
20	38	3	3
21	32	0	0
22	29	-2	0
23	43	6	6
24	40	4	4
25	38	3	3
26	36	2	2
27	42	6	6
28	41	5	5
29	43	6	6
30	48	9	9
31	50	10	10
Thaw Degree Days Month Value			74



Activity

Estimating Shrub Height

Today much of northern and western Alaska provides good moose habitat. Was this the case 100 years ago? It makes sense that shrubs grow taller where they have a longer growing season. Scientists have developed a formula that correlates the height of willow shrubs with Thaw Degree Days (TDD).

$$\text{shrub height (cm)} = 0.000341(\text{TDD})^2 - 0.195(\text{TDD}) + 27.7$$

Scientists developed this formula by conducting many repeated studies, in which they measured the tallest shrubs in a specific area and compared the shrub heights with temperature data. They correlated shrub height with the average TDD for the previous 10 years.

First, practice applying the formula to estimate shrub height.

1. For shrub height in 2010, use the average TDD for the years 2000-2009 in Nome, AK: 1285.
2. Does your answer seem reasonable? Keep in mind that other factors affect shrub height in addition to temperature, such as soil depth, nutrients, moisture, and sunlight. Your answer should indicate the height of the tallest shrubs in an area near Nome under good growing conditions.

Next, use the formula to estimate what shrub heights were in the past.


3. 1910 through 1919 is the first decade that temperature data is available for Nome, AK. The mean TDD for these 10 years is 1130. Use this number in the shrub height formula to predict the shrub height for 1920.
4. Based on your result, do you think there was good moose habitat near Nome in 1920?



Measuring shrubs growing on permafrost







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